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MERWINITE, A NEW CALCIUM MAGNESIUM ORTHO-SILICATE FROM CRESTMORE, CALIFORNIA

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INTRODUCTION

Some specimens from the contact metamorphic zone at Crestmore, near Riverside, California, thought at first to be monticellite, have proved on microscopic examination to be made up largely of a new mineral. For this new species the name merwinite is proposed in honor of Dr. Herbert E. Merwin, and in recognition of his work in mineralogy and petrography. The writers were assisted in the heavy solution separation of the mineral and in measuring some of the optical properties by Mr. A. R. Martinez, to whom they express their thanks.

OCCURRENCE AND ASSOCIATION

Merwinite occurs in considerable abundance in the contact metamorphic limestone in the quarries at Crestmore, near Riverside, California. Boulders made up of the minerals described below have at times been common on the quarry floor, but their position on the quarry face has not been determined. The boulders are often coated with a white alteration product, the alteration having penetrated them to the depth of several centimeters by means of veins, but the center of the masses has been found to consist of firm, fresh material. The main occurrence of the merwinite was, as far as known, at the Wet Weather Quarry, and its amount there was measurable in tons. A small mass was also exposed in the Commercial Quarry where it was associated with vesuvianite, well away from the contact and beyond the garnet zone. Specimens were collected as early

[1] Published with the permission of the Director of the United States Geological Survey and the Secretary of the Smithsonian Institution.

as 1913, but were called monticellite at the time. They were then obtainable in abundance at the Commercial Quarry, in the zones more distant from the contact.

The new mineral is intimately associated with gehlenite, spurrite and an undetermined mineral (A), with a little calcite and rarely yellowish or brownish vesuvianite. Merwinite is the predominant mineral in most of the samples examined. Gehlenite is abundant, spurrite somewhat less so, the mineral A is fairly abundant in some specimens, and calcite is present in small amounts. The merwinite, the mineral A, and the gehlenite are in interlocking grains, while the spurrite is interstitial or intergrown with merwinite. The spurrite is found only in close association with the merwinite and commonly forms a corona separating merwinite from calcite. Diopside and wollastonite are less intimately associated with the merwinite, and become abundant associates of the gehlenite where merwinite is absent.

The spurrite is easily identified by its optical properties and by the fact that it effervesces with acid. Its optical properties have been described elsewhere;[1] it has since been determined that $\beta = 1.672$ and $\gamma = 1.676$.

The gehlenite closely associated with the merwinite and spurrite gives low but normal interference colors and has a considerably higher birefringence than that associated with the diopside and wollastonite, which gives abnormal blue and red interference colors. Both are uniaxial, negative, and have a refractive index of about 1.663. These data indicate a gehlenite made up predominantly of velardeñite with about 25% åkermanite (oakermanite).

The mineral A is closely associated with the merwinite. It is optically negative, has a very large axial angle, with refractive indices: $\alpha = 1.640$ $\beta = 1.651$ $\gamma = 1.662$.

Optical properties

Merwinite has characteristic optical properties with high relief, moderate birefringence and polysynthetic twinning. The refractive indices as measured by the immersion method are:

$\alpha = 1.708 \pm 0.003$ $\beta = 1.711 \pm 0.003$ $\gamma = 1.718 \pm 0.003$

It is optically positive, has an axial angle measured with the

[1] W. F. Foshag: Thaumasite (and spurrite) from Crestmore, California. *Am. Min.*, 5 (4), 80–81, 1920.

Fedorov stage of $2V = 66\frac{1}{2}°$, and the dispersion $\rho > v$ is perceptible. The acute bisectrix Z is normal to the perfect cleavage. The mineral shows polysynthetic twinning after two laws. A drawing of the twins is shown in figure 1. The more common is in two or even more sets that yield cross gratings, "herring-bone" structure, and more complex arrangements. The two sets of lamellas are commonly not equally developed and so add to the complexity. In many grains the twinning resembles the albite twinning of the feldspars and, in one section, the merwinite is in

FIGURE 1. Drawing of a thin section of merwinite showing twinning. Magnified 40 diameters.

tabular crystals parallel to the best developed twinning, making the resemblance to calcic plagioclase still closer. Sections cut normal to both pairs of the two sets of twin lamellas have an angle between the lamellas of about $42\frac{1}{2}°$. Such sections show Z bisecting the obtuse angle between the twin lamellas for all the twin lamellas and X much inclined to the normal of the section. Hence such grains extinguish as a unit, but when not turned to the position of extinction the lamellas show different interference colors. A grain showing both sets of twin lamellas and cut

nearly normal to the planes of both is shown in the lower right hand corner of figure 1. Such a section when turned on the Fedorov stage on an axis parallel to Z shows symmetrical extinction and in the 90° position gives parallel extinction. Sections cut normal to Z give an extinction angle X to the trace of the composition plane of about 36°. For such sections Z is normal to the plane of the section for all the lamellas but alternate lamellas give symmetrical extinction X on the opposite side of the composition plane. These data indicate that the mineral is monoclinic; that Z = *b*, the composition plane is a prism (110) and the twinning axis is the crystallographic *c* axis. The cleavage is 010 and $X \wedge c = 36°$. The angle between (110) and $(1\bar{1}0)$ is 42½°.

The mineral has another less common set of twin lamellas that often appear in sections as lens-like streaks. In sections normal to *c* these lamellas bisect the acute angle between the more common sets of lamellas and hence extinction is parallel to them. In rare grains it turns the more common lamellas so as to give a "herring-bone" structure. In sections normal to the *b* crystal axis they give symmetrical extinction. This set therefore has the twinning plane and composition plane (100).

Physical properties

Merwinite has one perfect cleavage parallel to (010). Its hardness is about 6. The specific gravity, as measured by the pycnometer method, is 3.150. The mineral is colorless to very pale greenish and has a vitreous luster. The mixture has a light greenish to grayish color and somewhat greasy luster and bears a marked resemblance to the original specimens of spurrite from Velardeña, Mexico, now preserved in the United States National Museum (No. 86532). The original spurrite has a similar coating of white alteration products.

Chemical properties

Material for analysis was carefully separated from the associated minerals with heavy solutions and the resulting product showed under the microscope only one or two per cent. of admixed mineral A, gehlenite, and spurrite.

The mineral dissolves quickly and completely in hydrochloric acid and upon evaporation gelatinizes perfectly. The analysis was carried out by the standard methods, double precipitations

being made in all cases. The results of a complete analysis and a partial analysis are given below:

Table 1. Analysis of merwinite from Crestmore, Cal.

SiO_2	35.50	35.84
Al_2O_3	0.66	0.65
Fe_2O_3	none	none
CaO	49.96	49.70
MgO	11.62	——
FeO	1.22	1.23
Loss at 110°[1]	0.12	——
Loss on ignition[1]	0.94	——
	100.02	

By calculating FeO to MgO, deducting alumina and loss on ignition as extraneous and recalculating to 100 per cent. we obtain the following composition and ratios:

Recalculated analysis ratios and theoretical composition of merwinite

	Theor. Compn.	Recalcd. compn.	Ratios.	
SiO_2	36.59	36.50	.601	2
CaO	51.22	51.00	.911	3
MgO	12.19	12.50	.312	1

The formula for merwinite therefore is $3CaO.MgO.2SiO_2$, which may be written as a normal orthosilicate $Ca_3Mg\ (SiO_4)_2$.

Alteration

The surface of the boulders of merwinite-bearing rock is covered with a coating of alteration products and the outer portions are cut by veinlets of secondary minerals. These veins were probably developed during the later stages of the contact metamorphism. Chief of the alteration products is thaumasite occurring in masses of interlaced needles, small crystals lining cracks or silky, fibrous masses. This thaumasite has been described in another paper.[2] Other minerals are a fibrous, weakly birefracting to indistinctly polarizing material that resembles serpentine, and a clear, isotropic mineral with a refractive index of 1.673.

Relations

The compound $3CaO.MgO.2SiO_2$ does not appear in any of the lime-magnesia-silica systems which have been studied.

[1] Part of this was bromoform, used in the gravity separation.

[2] *Am. Min.*, **5** (4), 80, 1920.

Merwinite is therefore probably a low temperature form, breaking down before its melting point is reached. Its association with wollastonite indicates that it crystallizes below a temperature of 1190° C., the inversion temperature of wollastonite. Its occurrence in rocks of pneumatolytic contact metamorphic origin indicates a temperature much lower still.

Merwinite is not closely related to any known mineral. In composition it is similar to the olivine group, but it differs from olivine in crystallization.

THE MINERALS OF ST. LAWRENCE, JEFFERSON, AND LEWIS COUNTIES, NEW YORK.

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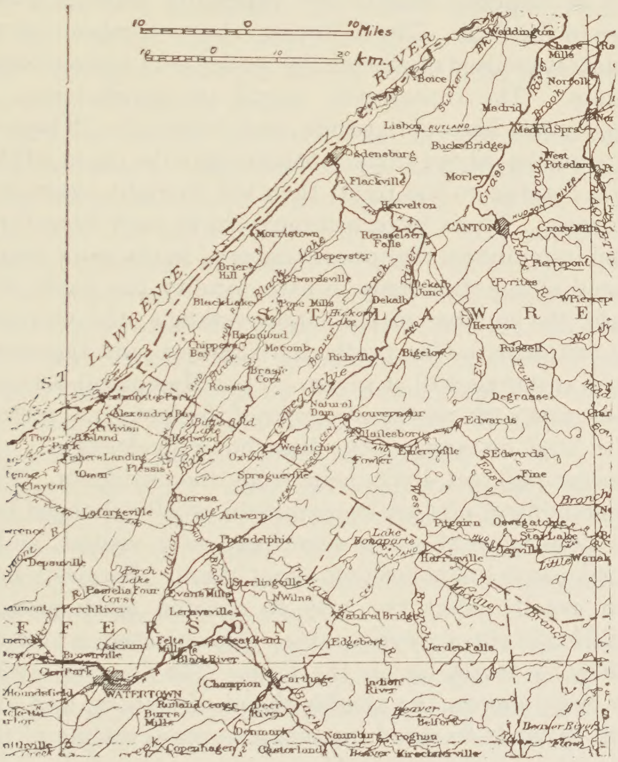
No introduction to the minerals of the western Adirondack region in upper New York State need be given to any one interested in mineralogy. Good crystals from its many localities adorn nearly all mineral collections and most of the easily obtainable show specimens were taken long ago. There is still a great deal left, however, which will repay a trip into the region, and many of the old localities may be made to furnish material nearly; if not quite, as good as that which made them famous. In view of this fact, coupled with the difficulty experienced in locating the exact position of some of the old collecting grounds from such directions as have been previously published, the writer feels that a new set of directions, along with a short account of what may be found at each place, will be welcome.

The region lies on the far western edge of the Adirondack plateau, bordering the heavily forested area, but mostly to the west of it. It is contained within the limits of St. Lawrence, Jefferson, and a corner of Lewis counties (see the accompanying map) and includes parts of the following topographic quadrangles: Hammond, Gouverneur, Lake Bonaparte, Russell, and Canton.

The territory is easily reached by automobile either thru the Adirondacks proper or, with better roads, northward from Utica up the valley of the Black River. The Rome, Watertown, and Ogdensburg R. R. runs north from Utica up the Black River valley, and connections may be had at Carthage for Natural Bridge, and at Philadelphia for Gouverneur, Canton, etc. The

main connecting roads of this region are very good and an automobile is a great assistance to travel, tho many of the dirt roads are decidedly bad at all times and impassable during wet weather. Good accommodations may be had in Gouverneur, Canton, Russell, Natural Bridge, in fact any of the little towns of the region, but if a prolonged stay be contemplated, the boarding house of Mr. and Mrs. Fairbanks at Oxbow is suggested as the place where



the best accommodations and food may be had. There is a small garage across the road which will keep a car.

The topography is very rough, but the differential elevations seldom attain more than 15 to 30 meters (50 to 100 feet) and are generally considerably less, a great many of the rock knobs falling within the 6.1 meter (20 foot) contour interval of the maps. The region about Gouverneur and to the west is mostly cleared. The limestone valleys are cultivated and the rocky ridges are either partly cleared grazing lands or are covered with

old burned slash which resists intrusion. A number of heavily wooded swamps furnish the hardest going, but these need not be invaded by the mineral seeker.

It is exceedingly difficult to give accurate directions, even with the aid of the topographic sheets of the region, to which the reader is referred. The topography is often inaccurately represented, while the bewildering sameness of ledges of white limestone and of bleached granite and pegmatite make it hard to find places in the field. The following scheme has been adopted as the quickest method of placing the reader near a given locality on the map.[1] The topographic sheets are divided into nine rectangles by the lines of latitude and longitude. These rectangles are numbered one to nine, beginning in the upper left hand corner and reading to the right, then left to right again in the next two rows. These large rectangles have each been further subdivided into nine smaller ones numbered in the same manner. At the head of the directions to each locality the name of the quadrangle, the number of the large rectangle, the number of the small rectangle in that particular large one, and the position in the small rectangle will be given. Thus Hammond-5-1-northeast corner means the northeast corner of the first small rectangle in the fifth large rectangle of the Hammond quadrangle.

A collector will get little help from the residents. Farms upon which mineral pits are located have usually changed hands since the time when the pits were frequently visited, and the present occupants know nothing about them. Requests for information usually point the way to nothing more promising than an old lead vein or a pyrite mine. No objection is ever made to a collector's searching on the land. The localities will be taken up beginning in the neighborhood of Oxbow, and an attempt will be made to avoid unnecessary criss-crossing of trails.

The region north of Oxbow. *Hammond*-8-1.

To reach this area go west out of Oxbow, bear right at the end of the street and go north taking the first left hand turn across the marsh. Take the next sharp left hand turn at the head of the marsh, 3 kilometers (1.9 miles) from Oxbow, and take the next right hand road 1.2 km. (¾ mile) west of here.

[1] It is similar to that used in some of the locality articles which have appeared in this magazine previously, especially those dealing with Pennsylvania localities, but the subdivision into ninths is not carried so far.

The first locality is situated one hundred meters up this road at the cut. On both sides of this road-cut small crystals of pyroxene, apatite, titanite, and disseminated phlogopite can be found. In the field immediately northeast of here there is a band of disseminated chondrodite in limestone. 0.3 km. (0.2 mile) east of the road cut, to the north of a wagon road running out of a farm yard by a wagon shed, and a hundred meters east of the wagon shed, there is a prominent 2½ meter cliff projecting slightly into the valley. This exposure gives tremolite, phlogopite, pyrite altering to limonite, brown tourmaline, and chondrodite, all in small crystals or grains.

About 150 meters (500 feet) east up the valley, under two maple trees side by side, there is a pit containing large phlogopite, apatite and some feldspar in good crystals. 0.6 km. (0.4 mile) N. 28° E. from this last locality, around the west end of a Potsdam sandstone mass and in a slightly raised valley, there is considerable phlogopite and some chondrodite. Sixty meters (200 feet) N. 10° E. from here over the point of a little hill, there is a concentration of brown tourmaline, tremolite, and boulders of phlogopite. About 50 meters N.E. of the last locality but one, on the slope of a small hill, there are nodules in the limestone containing serpentine, chondrodite, spinel, and calcite.

At the head of the valley of a small stream flowing northeast, a little over 160 meters (1/10 mile) from the last locality and almost due north of it, there is a cut in the limestone in which abundant apatite, green pyroxene, titanite, some graphite, and brown tourmaline are developed.

Going back to the last right hand turn on the road before reaching the first locality, continue straight west on the other road (instead of making the right hand turn) and go for 0.4 km. (¼ mile) past a farm on the right. Then turn northwest across an open field in the valley of the brook, pass a well, and, going half way up the hill, bear west until the southwest end of the first and highest point of the hill, forming the northern side of the valley, is reached. At the base of this cliff many boulders of phlogopite can be found. A band of chondrodite will be seen to circle the northwest side of the hill and continue to the southwest. Thirty meters (100 ft.) in this direction from the end of the hill the chondrodite is fairly massive and contains good octahedra of purple spinel up to 2.5 cm. in diameter. The best spinels can be dug out of a crack in the rock with the aid of a small stick. A

bit of powder here would undoubtedly bring more to light. Nearly ½ km. (⅓ mile) southwest of here along the crest of the hill and just beyond the wood and the next high point of the hill there is a further concentration of wernerite, pyroxene, phlogopite, and a little brown and black tourmaline in a pocket along the edge of a dike. About 30 meters south of here there is some chondrodite and pinkish spinel. 225 meters farther southwest, at the head of the northeast pointing V in the northwest running road, there is a white limestone holding purple spinel and light green serpentine, yielding beautiful specimens.

Rossie. *Hammond*-4-3, on eastern boundary, south of center.

This is one of the old mineral localities which has not been completely despoiled. Roughly 2½ km. (1½ miles) north from the road crossing the Indian River in the village of Rossie, on the road to Hammond thru B. M. 361, about 0.4 km. (¼ mile) southwest of the last house to the north of the road just before it crosses Grass Creek, and up the first valley southeast of the valley of Grass Creek, there is a cliff 6 m. high and 100 m. long. This cliff is on the northwest side of the valley just beyond a wire fence. It is a good place to see black tourmaline and quartz. A pocket of rose quartz may be found on top of the cliff near its north end.

Continuing diagonally south across the valley from the southwest end of the cliff thru a cleft into a small open field, then south again for 30 meters thru a narrow, boulder strewn valley, a 4 x 10 m. face of rock covered with crystals will be found. The crystals form a mesh which precludes the collecting of individuals, but by digging at the base of the cliff the writer was able to find some slabs of the contact surface up to 3 x 5 dm. in size. The following minerals can be found here: apatite, in blue green to yellow green crystals from 5 mm. to 15 cm. in length and 2.5 cm. in diameter; pyroxene, dark green to nearly black stubby crystals as much as 8 to 10 cm. long and 5 cm. thick; feldspar, in dull crystals 5 cm. thick and in small well preserved crystals; titanite, in small reddish brown crystals and grains; scapolite in rare weathered crystals; and pink calcite filling the interstices between the other minerals. The mineralized zone gives out immediately south of the face but the contact may be followed north along the cliff as an irregular, pockety zone containing the same minerals, and out into the field crossed in coming where

some pegmatites bearing white mica and black tourmaline will be found. The best time to visit this face is before ten o'clock in the morning for the sun then shines directly upon it. This region is also noted for the development of mica and calcite but the writer was unable to find anything but the scantiest remains of a few old mica diggings.

Rossie Lead Mines. *Hammond*-4-3-west center.

West of the farm to the west of the road 0.4 km. (¼ mile) south of the street corner in Rossie a chimney, the only relic of a former furnace, may be seen standing. The ore is in a vein back of this and in a dump in front of the old furnace. It occurs as coarsely crystalline galenite and sphalerite in a white to pink calcite. There are a number of other lead veins in this region occurring in the granite mass south and west of Rossie. One and one half kilometers (0.9 mile) along the road leading west, just south of the Rapids School, at the second southerly leading road, there is another pit and an old furnace. These lead mines are all alike.

North of Grass Lake. *Hammond*-4-8-east center.

Three quarters of a kilometer (½ mile) west of Robb School, on the eastern side of the ridge running northeast from the end of the road near Grass Lake, at the edge of a patch of thin woods (a little north of the green patch on the map), there is a cliff at the base of which some digging has been done. Coarse calcite, pyroxene, some light green apatite, considerable graphite in brilliant plates, some pyrrhotite, quartz, and phlogopite can be found here.

About 160 meters (1/10 mile) northeast of this locality, on the top of a little bare knob in an open field (shown as a small, round, single contour on the map), there is a development of large dark green pyroxenes in crystals 5 cm. thick and as fragments of larger crystals with prism faces 8 to 10 cm. across, or as cleavage pieces as large as cobbles. Along with these there is an abundant development of wedge-shaped titanites in quartz, large feldspars, and coarsely crystalline calcite. There is also a small development of purple fluorite along the eastern edge of the hillock. As usual the best has been taken from this spot but there is some good material left.

(To be concluded)

PROCEEDINGS OF SOCIETIES

NEW YORK MINERALOGICAL CLUB

On the evening of Tuesday, May 17th, 1921, a reception was given at the American Museum of Natural History, New York, to Madame Curie. At this meeting she was presented with a diploma conferring honorary life membership in the New York Mineralogical Club, which read as follows:

THE NEW YORK MINERALOGICAL CLUB

BY UNANIMOUS VOTE OF ITS MEMBERS AT THE ANNUAL MEETING OF THE ORGANIZATION ON THE EVENING OF WEDNESDAY, APRIL THE TWENTIETH, 1921, AT THE AMERICAN MUSEUM OF NATURAL HISTORY, DESIRING TO EXPRESS ITS FULLEST APPRECIATION OF THE EMINENCE ATTAINED BY HER IN THE FIELD OF SCIENCE, AND HER TRANSCENDENT SERVICE TO HUMANITY THROUGH THE DISCOVERY OF RADIUM IN THE YEAR 1898, AND HER MANY AND GREAT CONTRIBUTIONS TO THE SCIENCE OF RADIO-ACTIVITY HEREBY CONFERS UPON

MADAME MARIE SKLODOWSKA CURIE

HONORARY MEMBERSHIP, WITH LIFE TENURE OF ALL THE RIGHTS AND PRIVILEGES PERTAINING THERETO.

George F. Kunz, President.
George E. Ashby, Vice-President.
Herbert P. Whitlock, Recording Secretary.
Wallace Goold Levison, Corresponding Secretary.

Special Committee Madame Curie Reception

Held at the American Museum of Natural History, Tuesday, May 17th 1921.

O. Ivan Lee	Alexander H. Phillips
Agnes Vinton Luther	Herbert P. Whitlock
James G. Manchester	George F. Kunz, Chairman.

A full account of the meeting has been published in *Natural History*, **21** (2), 162–165, 1921, under the title "Science honors Madame Curie at the American Museum."

NOTES AND NEWS

The Second Annual Meeting of the Mineralogical Society of America is to be held on December 29th, 1921, at Amherst, Massachusetts. Mineralogists intending to present papers at this meeting should send titles to the Secretary, Herbert P. Whitlock, American Museum of Natural History, New York City, as soon as convenient. It is hoped to publish the preliminary list of papers about December 1st.

Mr. George Letchworth English, for some years manager of the Department of Mineralogy and Petrography of Ward's Natural Science Establishment, has resigned from that position, but is retained in a consulting capacity. Dr. Alfred C. Hawkins, who has been engaged in crystallographic work for the Du Pont de Nemours Co., Wilmington, Delaware, has resigned from that company to join the staff at Ward's.